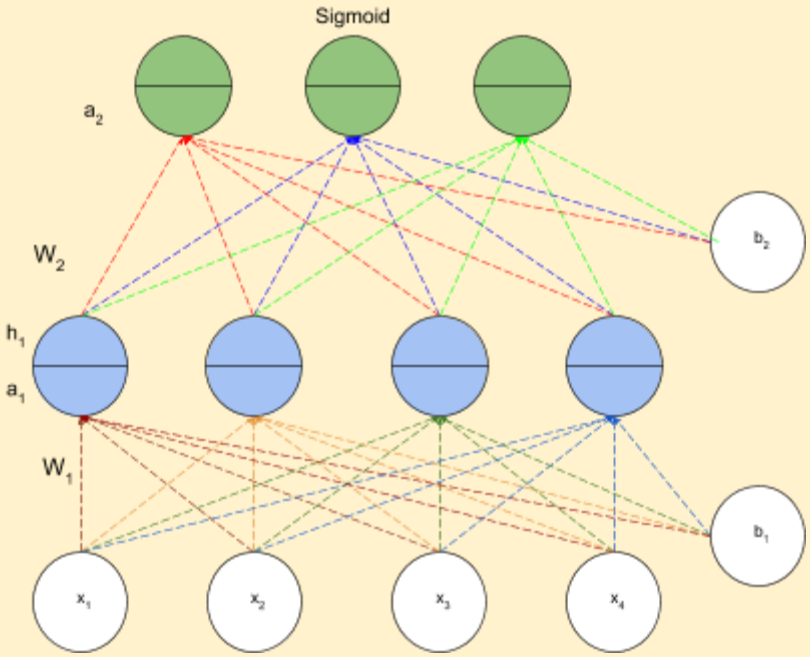
PadhAI: Deep Neural Networks

One Fourth Labs

Loss function for Multi-Class Classification

What is the loss function that you can use for a multi-class classification problem

1. Here is an illustration of a sample multi-class classification Neural Network



2. Consider the following values for the parameters
   a. b = [0 0]
   b.

$$W_1 = \begin{bmatrix} 0.1 & 0.3 & 0.8 & -0.4 \\ --0.3 & -0.2 & 0.5 & 0.5 \\ -0.3 & 0.1 & 0.5 & 0.4 \\ 0.2 & 0.5 & -0.9 & 0.7 \end{bmatrix}$$

   c.

$$W_2 = \begin{bmatrix} 0.3 & 0.8 & -0.2 & -0.4 \\ 0.5 & -0.2 & -0.3 & 0.5 \\ 0.3 & 0.1 & 0.6 & 0.6 \end{bmatrix}$$

3. Consider a case where x = [-0.6 -0.6 0.2 0.3] and true class y =[0 1 0]
4. The output values are as follows
   a. $a_1 = W_1 * x + b_1 = [-0.19 \ -0.16 \ -0.09 \ 0.77]$
   b. $h_1 = sigmoid(a_1) = [0.45 \ 0.46 \ 0.49 \ 0.68]$
   c. $a_2 = W_2 * h_1 + b_2 = [0.13 \ 0.33 \ 0.89]$
   d. $\hat{y} = softmax(a_2) = [0.23 \ 0.28 \ 0.49]$
   e. Cross Entropy Loss
      i. $L(\Theta) = -\Sigma^k_{i=1} y_i log(\hat{y}_i)$
      ii. $L(\Theta) = -1 * \log(0.28)$
      iii. $L(\Theta) = 1.2729$
5. Consider another case where x = [0.6 0.4 0.6 0.1] and true class y =[0 0 1]
6. The output values are as follows
   a. $a_1 = W_1 * x + b_1 = [0.62 \ 0.09 \ 0.2 \ -0.15]$
   b. $h_1 = sigmoid(a_1) = [0.65 \ 0.52 \ 0.55 \ 0.46]$
   c. $a_2 = W_2 * h_1 + b_2 = [0.32 \ 0.29 \ 0.85]$
   d. $\hat{y} = softmax(a_2) = [0.2718 \ 0.2634 \ 0.4648]$
   e. Cross Entropy Loss
      i. $L(\Theta) = -\Sigma^k_{i=1} y_i log(\hat{y}_i)$
      ii. $L(\Theta) = -1 * \log(0.4648)$
      iii. $L(\Theta) = 0.7661$
7. A quick summary of what we've learned so far
   a. Given weights, we know how to compute the model's output for a given input
   b. This is called Forward-propagation.
   c. Given weights, we know how to compute the model's loss for a given input
   d. But who will give us the weights?
8. The weights can be obtained from the learning algorithm